Before the

Federal Communications Commission

Washington, D.C. 20554

In the Matter of	)	
Misuse of Internet Protocol (IP) Captioned Telephone Service	)	CG Docket No. 13-24
Telecommunications Relay Services and Speech-to-Speech Services for Individuals with Hearing and Speech Disabilities	)	CG Docket No. 03-123

Comments of the Rehabilitation Engineering Research Center on Telecommunications Access

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Christian Vogler, Ph.D.,
Co-Principal Investigator, RERC-TA
Director, Technology Access Program;
Linda Kozma-Spytek, M.A., CCC-A
Research Audiologist, Technology Access Program;
Paula Tucker, Ed.S.
Research Associate, Technology Access Program,
Gallaudet University
800 Florida Ave., NE, SLCC 1116
Washington, DC 20002
(202) 250-2795

Gregg C. Vanderheiden, Ph.D.,
Co-Principal Investigator, RERC-TA
Director, Trace R&D Center
University of Wisconsin-Madison
1550 Engineering Drive, 2107 ECB
Madison, WI 53706-1609
(608) 262-6966

I. Introduction

The Telecom RERC (RERC-TA) is a joint project of the Technology Access Program at Gallaudet University and the Trace Center at the University of Wisconsin-Madison. The RERC is funded by the U.S. Department of Education, National Institute on Disability and Rehabilitation Research, to carry out a program of research and development focused on technological solutions for universal access to telecommunications systems and products for people with disabilities.

The RERC-TA would like to respectfully offer its comments on the FCC Order and Notice of Proposed Rulemaking on the Misuse of Internet Protocol Captioned Telephone Service (IP CTS). These comments contain an analysis of the growth of IP CTS based on the publicly available Interstate TRS fund data, with the conclusion that a linear forecast model has been a poor fit for the actual IP CTS growth since its inception, and that as a consequence, there is little evidence to support a spike in IP CTS usage in recent months. In addition, the RERC-TA provides further evidence against using dB criteria as a CTS eligibility criterion, based on recent original research. To address some of the questions and concerns of the FCC in the NPRM, a survey is currently underway, which closes on March 8, 2013. An initial analysis will be provided in an ex parte filing by the end of March.

II. Analysis of the IP CTS Growth Model

The RERC-TA is concerned that a focus on short-term data obscures the long-term behavior of the IP CTS growth over time, and that the model used for TRS fund

projections is not in alignment with how CTS actually has grown over time. The information on growth offered in the NPRM is limited to a time period of eight months[1], while the historical information graphed in the monthly RLSA TRS fund status reports is limited to a time period of nine months[2]. Based on these limited time windows, the impression arises that the growth of IP CTS minutes is largely linear and that there is a recent sharp uptick of the slope. The TRS fund projections methodology makes the same assumption about linearity, as described in the annual TRS fund report[3].

However, an analysis of call minutes over extended time periods reveals that the growth of IP CTS has *never been* linear, and that, in fact, the growth between January 2010 and December 2012 has been following an exponential trajectory all along. The figure below shows a regression of the call minutes during this time period to an exponential curve with an R-squared coefficient of over 0.99. The data for this curve were obtained from the historical NECA TRS fund data[4], as well as the monthly RLSA TRS fund status reports.

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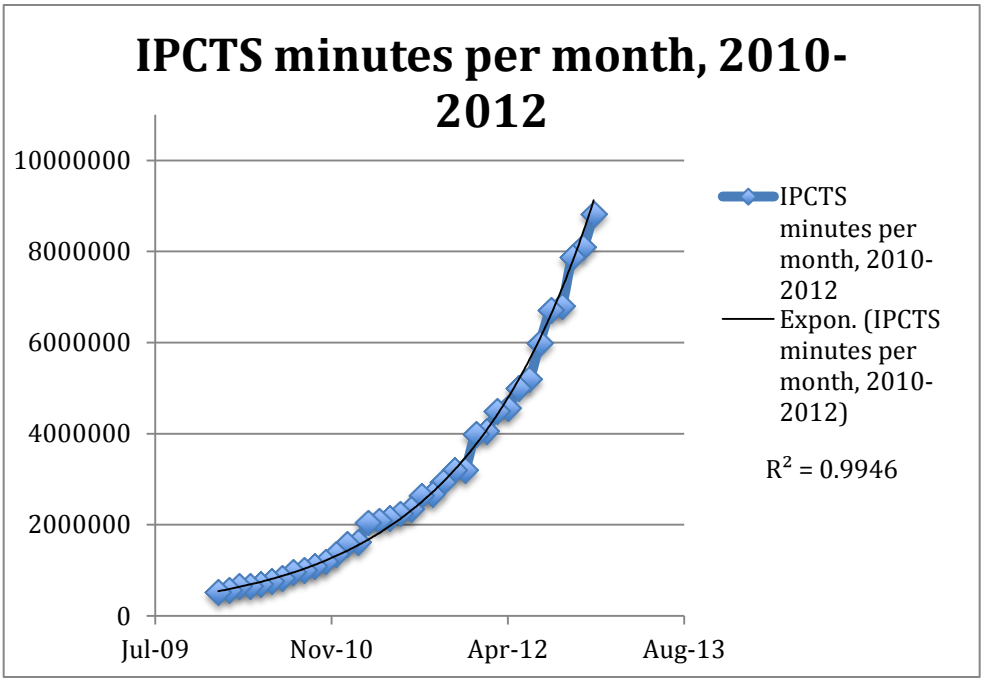
[1] Order and Notice of Proposed Rulemaking, CG Docket No. 13-24 and 03-123, 01/25/2013, at 6: graph depicting growth from March through October 2012, and showing deviation from projected minutes.

[2] Rolka Loube Saltzer Associates Interstate TRS Fund Reports. Online: http://www.r-l-s-a.com/TRS/Reports.htm (last retrieved: 2/26/2013).

[3] Rolka Loube Saltzer Associates Fund Projection as of May 31, 2012. Online: http://www.r-l-s-a.com/TRS/reports/2012AnnualFiling.pdf (last retrieved: 2/26/2013)

[4] Filing by National Exchange Carrier Association. CG Docket 03-123, 04/29/2011.



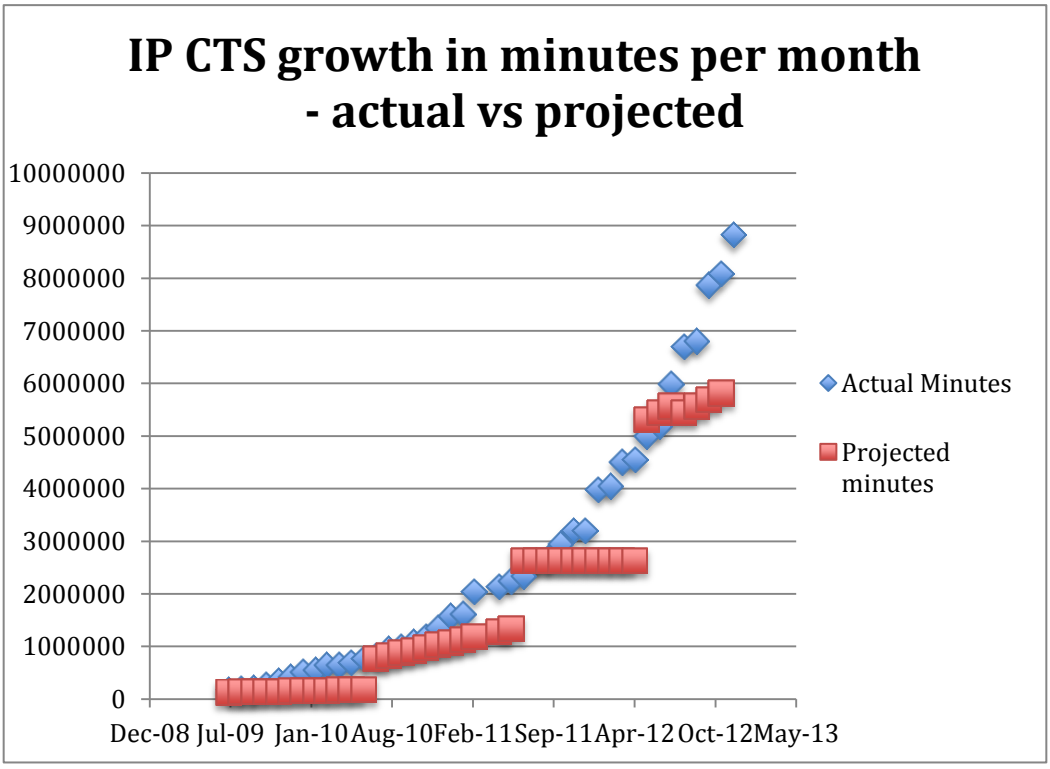
Year	Cumulative reported minutes	Year-to-year rate of growth
2008	677,658	--
2009	2,413,506	356%
2010	10,237,622	424%
2011	28,712,699[5]	280%
2012	71,587,706	249%

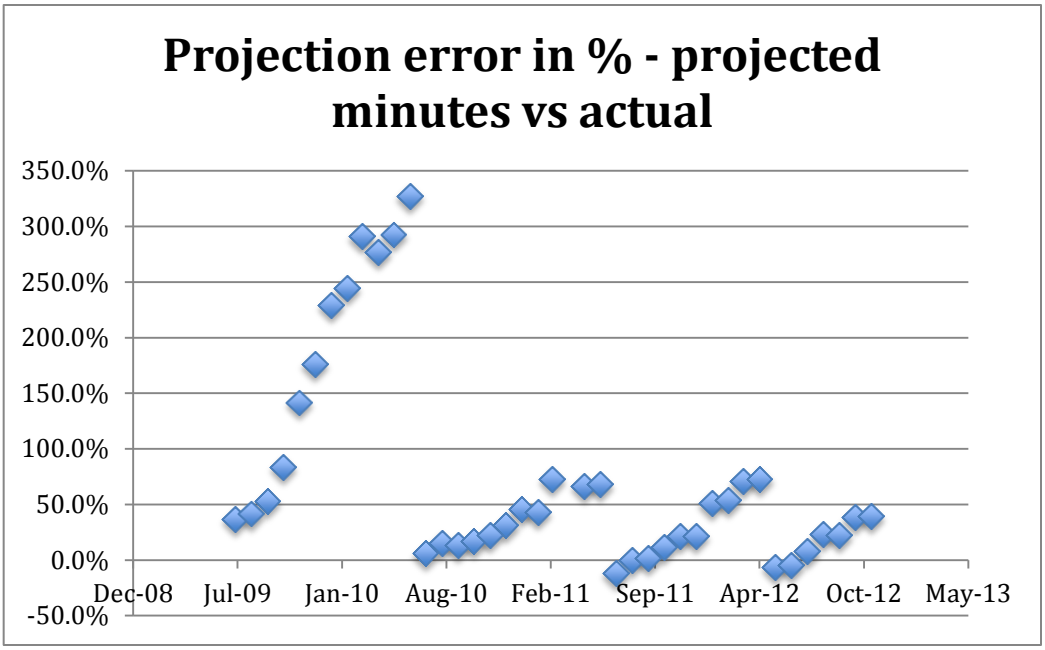
Under an exponential growth model, which as shown above, fits the available data on the IP CTS growth much better than a linear model, there is no discernible uptick in IP CTS growth during recent months. Rather, the apparent uptick is attributable to the

[5] Estimated, due to missing data for the June 2011 RLSA TRS fund report.

growing discrepancy between a linear growth trajectory and an exponential growth trajectory even over the relatively short eight-month period of reporting. On an annual basis, the growth of IP CTS is still slowing down as of December 2012, with the rate of growth shown in the table above.

Another reality of the IP CTS growth is that the projections by the interstate TRS fund administrator have never been in close alignment with the actual growth in minutes for any reporting period. The mismatch between projections and actual minutes is thrown into stark relief in the next two figures. Of particular note is that if a linear growth model were a good fit for actual IP CTS growth, the percentage error between projected and actual minutes would be constant over a reporting period, but in fact, this error almost always has increased monotonically from month to month over every reporting period.





In addition, the figure comparing projections with actual minutes shows that, in 2011 and 2012, the slope of the reported linear projections[6] is not consistent with the slope of the actual IP CTS minutes at the time when the projections were made. In both years, the projected slope looks to be shallower than the actual slope of the growth curve in the preceding months. (Note that the break in the projection for 2012 in the figure above looks like a reporting error in the Interstate TRS fund that causes the reported projections to be off by two months, but does not change the nature of the argument.) The RERC-TA attempted to reproduce the slope of the 2012-2013 IP CTS projections using linear regression in Excel, as described in the annual TRS fund report for 2012[7], but was unable to do so, for the reporting period July 2011 to February 2012, and any other combinations of 2011-2012 fund data. Visual inspection of the graph suggests that the slope of the

[6] As taken from the monthly RLSA TRS fund status reports.

[7] Rolka Loube Saltzer Associates Fund Projection as of May 31, 2012, p. 15, footnote 33.

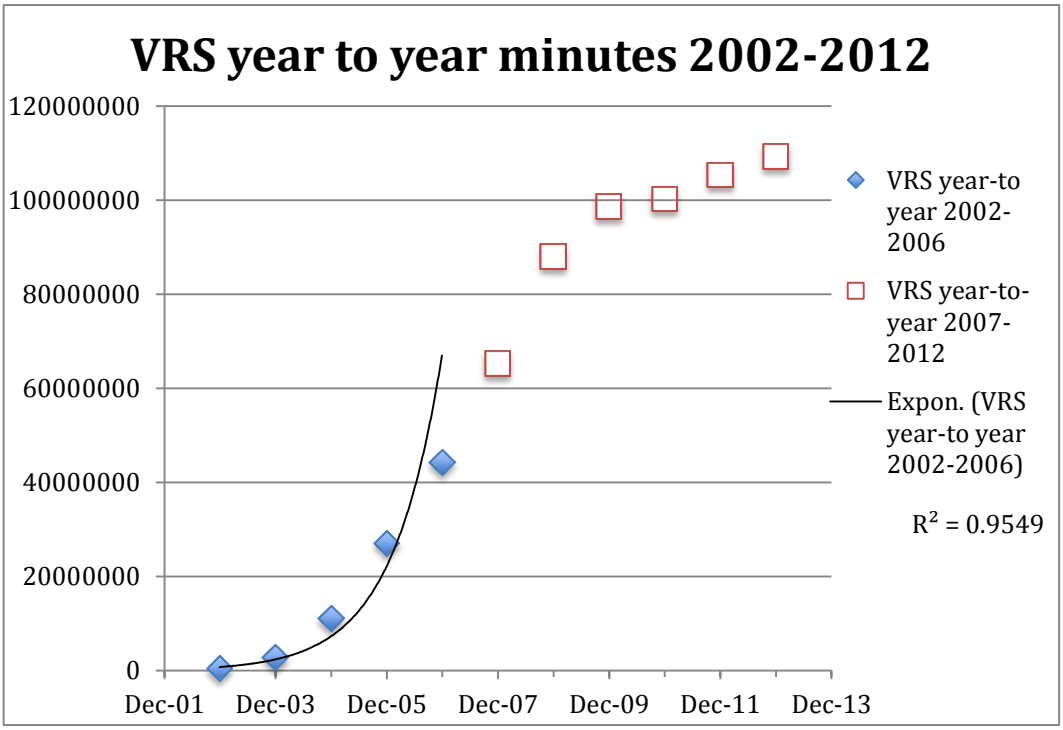
projections for 2012 is consistent with the usage seen in the second half of 2010, rather than the second half of 2011. It is also not clear why the reported projections for 2011 should be flat, or whether these constitute errors in the TRS fund reporting.

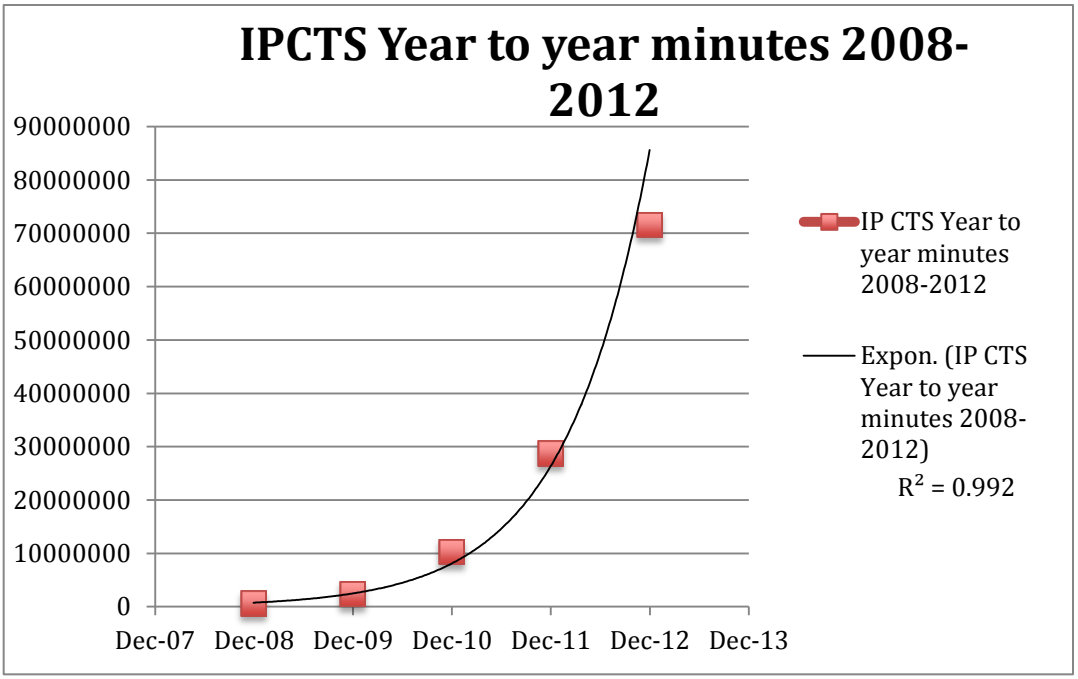
Given the problems identified with the projections, the RERC-TA respectfully suggests that enough information be made available to reproduce the projections for IP CTS over the years. In addition, it is clear that a linear projection model has historically never been a good fit for the characteristics of IP CTS.

The FCC also asks whether "the growth in IP CTS [is] the result of a natural growth curve, wherein consumer acceptance of new products is initially slow, followed by a period of rapid growth that ultimately levels off."[8] The RERC-TA would like to offer a comparison of IP CTS with the growth of VRS over time for this purpose, available via the historical NECA filings and the RLSA TRS fund status reports. Because prior to the year of 2008 only the annual cumulative minutes are available for VRS in the historical fund information by NECA[9] – at a time when VRS growth had already reached the saturation point –, the comparison is also provided for the annual minutes only, with the ensuing loss of precision. The next two figures compare VRS and IP CTS over time.

[8] Order and NPRM at 43.

[9] Filing by National Exchange Carrier Association. CG Docket 03-123, 04/29/2011. Exhibits 3-6 and 3-7.


VRS year to year minutes 2002-2012
120000000
100000000
80000000
60000000
40000000
20000000
0
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
VRS year-to year 2002-2006
VRS year-to-year 2007-2012
Expon. (VRS year-to year 2002-2006)
R² = 0.9549


IPCTS Year to year minutes 2008-2012
90000000
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
IP CTS Year to year minutes 2008-2012
Expon. (IP CTS Year to year minutes 2008-2012)
R² = 0.992

The VRS growth from 2002 to 2010 displays the characteristics of an S-curve, which is a common growth pattern for new technology.[10] Initial adoption is slow, followed by rapid exponential-like growth, which eventually levels off. The figures also have an exponential curve fitted to the first five years of growth for easier reference: it can be seen that the overall shape of the first five years for VRS and IP CTS bear a resemblance to one another. Although, at this point, it is too early to tell whether IP CTS growth is indeed following an S-curve – and if so, which phase of the S-curve IP CTS growth currently is on –, the RERC-TA would like to raise the possibility, for further discussion and analysis, that observed IP CTS growth is not inconsistent with undergoing the stages of slow initial growth, followed by rapid expansion, and eventual leveling-off.

The RERC-TA also would like to point out that none of the preceding analysis precludes the possibility of misuse of IP CTS. However, the RERC-TA respectfully disagrees with the FCC that the available data on IP CTS growth provide strong evidence for such misuse. As stated above, a spike in IP CTS usage is not supported by the available data analyzed in a larger context. Moreover, there are serious methodological concerns about the TRS fund projections. The mismatch between a linear model and the actual growth curve is especially troubling, as is the mismatch between the projected slopes and the observed slopes at the times of projection. If methodological errors are

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[10] See e.g. B. Hall and B. Khan. Adoption of New Technology. In New Economy Handbook, Hall and Khan (eds), 2002. Online: http://elsa.berkeley.edu/~bhhall/papers/HallKhan03%20diffusion.pdf (last retrieved: 2/26/2013); Kim, Y. Technology Adoption S-Curve, http://www.ysk.com/blog/archives/000115.html (last retrieved: 2/26/2013)

indeed present, the consequences of such errors should not land on deaf and hard of hearing consumers, who rely on IP CTS for functional equivalence.

III. dB HL Levels as Criteria for CTS Eligibility

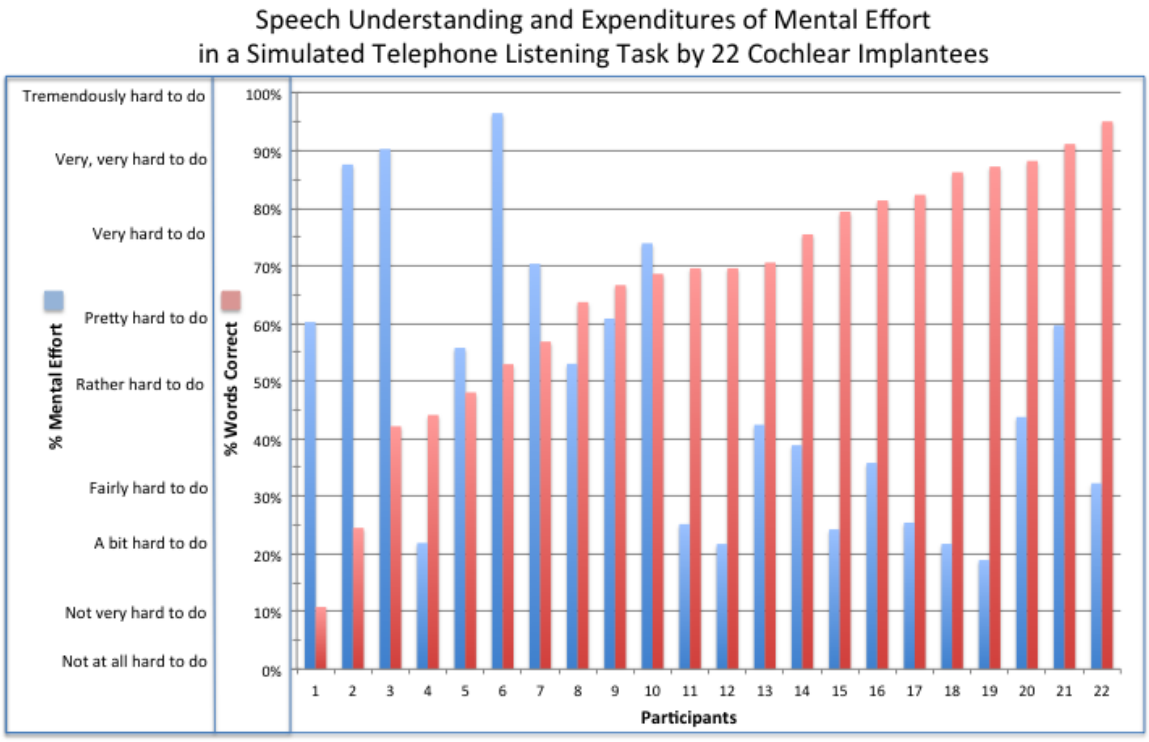
In our previous ex parte filing, we expressed serious concern about using dB HL levels as criteria for captioned telephone service eligibility[11]. Here we expand our reasoning and provide a substantive example as supporting evidence. Predicting the need for captioned telephone service with a single value derived from an audiogram belies the complex nature of speech understanding for individuals with hearing loss and in particular, older individuals with hearing loss. While the audibility of speech is a significant factor in explaining the deficits individuals with hearing loss experience in understanding speech, other factors, such as auditory distortions and susceptibility to background noise, can be responsible for further reductions in speech understanding capabilities. As such, simply providing additional sound level through amplification (whether through the use of a hearing device or amplified handset) does not fully ameliorate the speech understanding difficulties especially in noisy situations. Even if speech audibility alone were able to fully predict speech understanding, a single dB value derived from an audiogram would not adequately characterize the hearing loss in order to assess audibility. For an accurate assessment of audibility, it is critical to characterize the configuration of the hearing loss across the speech frequency range.

[11] L. Kozma-Spytek and C. Vogler, Ex Parte Letter, CG Docket 03-123, 12/20/2012.

In addition, the range and types of listening demands that are encountered in everyday listening situations and factors, such as age, that are particular to the individual, will affect speech understanding. For example, researchers have found that speech understanding declines for difficult listening situations with increasing age. Telephone communications is a difficult everyday listening situation for many individuals with hearing loss primarily because the listener cannot see the other person on the call. Important information about what s/he is saying and their emotional intent is carried on the face.

Some recent research carried out by the RERC-TA illustrates some of the points made above. A group of 22 cochlear implant (CI) users' speech understanding was assessed for a simulated telephone listening task in a quiet situation. The assessment was part of an experiment that comprised this and additional conditions. Each of the CI users listened to recordings of a woman speaking a total of 12 sentences, and after each sentence, the CI user was asked to repeat each word spoken. The recordings were processed using the same coding strategy implemented over the landline telephone, and presented at a typical telephone sound level. The percentage of words correctly repeated reflects the CI users' speech understanding abilities. In addition to assessing speech understanding, the degree of mental effort expended to complete the speech-understanding task was assessed using the Subjective Mental Effort Questionnaire. Individuals rate the amount of mental effort expended by providing a rating value on a scale that ranges from 'not at all hard to do' to 'tremendously hard to do.' Each rating was then converted to a percentage of the maximum effort rating on the scale.

The results of this experiment, displayed in the figure below, emphasize a number of points made in the above text. It is important to note that hearing levels for cochlear implantees, when wearing their devices, are typically level across frequency and fall within the mild hearing loss category. All the CI users in our study reported easily hearing tones up to 7000 Hz at soft speech levels. They also reported speech was comfortably loud at the sound presentation level used in the experiment. In spite of this, the speech understanding in quiet of the individual CI users varied considerably over a large range - from a low of 11% words correctly understood (see subject 1's red bar on the graph) to a high of 97% words correctly understood (see subject 22's red bar on the graph). The mental effort needed to complete the speech understanding task varied considerably as well, and generally has a somewhat inverse relationship with speech understanding performance. That is, the better speech understanding a person had, the less mental effort was expended on the task. However, it should be pointed out that even the CI users who reported expending low levels of mental effort still found the speech understanding task 'a bit hard to do,' even in quiet.



In contrast, research audiologist and joint filer of these comments, Linda Kozma-Spytek, would predict that any person without hearing loss would achieve near perfect speech understanding on this task and rate it as 'not at all hard to do.' Attempting to use a single number to qualify individuals for captioned telephone service will necessarily eliminate access to a needed service for some individuals with hearing loss and an absolutely essential service for others, and produce a situation in direct opposition to them achieving functional equivalency for telephone use.

IV. Survey to Collect Information on IP CTS Use

An online survey was designed by the RERC-TA to document current usage of Internet Captioned Telephone Services (IP-CTS) by adults who are deaf or hard of hearing. The goal of the survey was to understand 1) the demographics, including

severity of hearing loss, of people who use IP-CTS, 2) how important the availability of captions is to them to make and receive telephone calls, 3) whether they use captions for all telephone calls, 4) whether they share their equipment for using IP-CTS with other members of the household who do not have a hearing loss, 5) how they found out about IP-CTS and how they obtained their equipment, and 6) what call quality problems may exist that prevent people from using IP-CTS or result in an unsatisfactory call experience. The data collection period began on February 21, 2013, and will run through March 8, 2013.

The RERC-TA will file an ex parte with initial analysis by the end of March. In addition to collecting demographics and information about participants' hearing loss, the survey touches on topics related to the following questions:

1) How much of the growth of IP-CTS is related to fraud or misuse?
2) Is such growth attributable to the free distribution of equipment?
3) Is the equipment shared with members of the household without hearing loss, and if so, do they know how to turn captions off?
4) How important are the captions to IP CTS users, and how satisfied would they be with the call experience if captions were unavailable?
5) Do they know that IP CTS is intended for people with hearing loss, and do they understand that the cost of IP CTS is funded by the TRS fund?

V. Other Topics

The RERC-TA would like to raise the following other topics related to IP CTS, with the understanding that there will be a more in-depth follow-up during the reply-to comments phase:

- Before a default-off setting for captions is made permanent, it is imperative that a usability study by an independent research group be conducted, especially to assess the impact on persons with a visual impairment or a cognitive disability.
- Before adopting the traditional ASA standards of ten seconds for IP CTS with a default-off setting for the captions, it is necessary to assess the impact on the remote party who may not be familiar with relay services. Unlike with every other type of relay service, where the relay operator is on-line by the time the call connects to the remote party, with IP CTS and a default-off setting, the remote party may get connected before the relay operator comes online. If the remote party is unfamiliar with relay services, the wait at the beginning of the call due to long ASA standards could cause confusion.
- It is also necessary to plan ahead and ensure that IP CTS will be interoperable with NG9-1-1 standards for voice and real-time text, as well as total conversation terminals.

VI. Conclusion

The RERC-TA respectfully requests that the FCC consider these comments; and especially focus on the methodological concerns with TRS fund projections, as well as the grave concerns with adopting a dB-based eligibility criterion. As mentioned above, an initial analysis of the IP CTS survey results will be filed by the end of March.

Respectfully submitted,

On behalf of the RERC-TA[12]:

/s/ Christian Vogler

Christian Vogler, Ph.D.,
Co-Principal Investigator, RERC-TA
Director, Technology Access Program;
Linda Kozma-Spytek, M.A., CCC-A
Research Audiologist, Technology Access Program;
Paula Tucker, Ed.S.
Research Associate, Technology Access Program,
Gallaudet University
800 Florida Ave., NE, SLCC 1116
Washington, DC 20002
(202) 250-2795

/s/ Gregg C. Vanderheiden

Gregg C. Vanderheiden, Ph.D.,
Co-Principal Investigator, RERC-TA
RERC on Telecommunications Access,
Director, Trace R&D Center
University of Wisconsin-Madison
1550 Engineering Drive, 2107 ECB
Madison, WI 53706-1609
(608) 262-6966

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